able to identify a great many. Nilosyrtis appeared, however, very dim and small when compared to the Syrtis Major, which, at this time, is "probably in its maximum state of expansion." Ceberus, on the other hand, was observed to be very straight, wide and dark, and, it was thought, exhibited signs of gemination.

"HIMMEL UND ERDE."—The first number of the ninth year of this monthly contains many articles and notes of astronomical interest. Dr. G. Witt, of Berlin, contributes an account of the present state of our knowledge with regard to the planet Saturn, this being the first of two articles on this subject. The question of the origin of the surface markings on our satellite, the moon, is next raised, and the explanation given by Lœwy and Puiseux is brought into discussion. There are, also, two short notes on the rotation period of Venus and a remnant of the Biela comet. The former deals with Perrotin's work, while the latter informs us that Mr. W. E. Hidden, of Newark, U.S.A., is in possession of a piece of the meteorite, weighing 4·090 kilograms, which fell on November 27, 1885, in the neighbourhood of the town of Mazapil. This has been handed over to him by the director (Prof. Bonilla) of the observatory in Zacatecas (Mexico) for a mineralogical investigation. A brief account is given, also, of the new meteorological observatory adjoining the hotel on the top of the Brocken, and a short summary of the new contributions on the measurements of the heights of clouds, by Prof. Kaiser, in Danzig, and Prof. Koppe, in Brunswick.

THE REPORT OF THE ROYAL COMMISSION ON VACCINATION.

THE Report of the Royal Commission on Vaccination is one of the most moderate, and certainly one of the most convincing that has come from any Royal Commission during recent years. The Commissioners have, for seven years, been occupied in making most careful inquiries at all sources as to the efficacy of vaccination in rendering children (and adults) less susceptible to infection by small-pox virus. No trouble has been too great, and no expense has been spared to obtain accurate information as to the truth of statements made by the witnesses who appeared before the Commission; as to the trustworthiness of figures placed in evidence; as to the nature of the disease alleged to be due to vaccination; and as to the exact share that legal compulsion has had in promoting or preventing the vaccination of children. The conclusions at which the Commissioners have arrived are evidently based on the most thorough conviction that the evidence before them, after the careful sifting through which it has gone, is to be thoroughly trusted, whilst their recommendations as regards the alteration in the methods of operation, registration, and legal compulsion certainly appear to be those best calculated to increase the efficiency of vaccination, concerning the value of which they are so thoroughly convinced.

The main considerations of the Commission are arranged under a series of headings, which may first be taken seriatim.

(A) "As to the effect of vaccination in reducing the prevalence of, and mortality from, small-pox." Here they conclude "(1) that it diminishes the liability to be attacked by the disease; (2) that it modifies the character of the disease, and renders it (*a*) less fatal, and (*b*) of a milder or less severe type; (3) that the protection it affords against attacks of the disease is greatest during the years immediately succeeding the operation of vaccination. It is impossible to fix with precision the length of this period of highest protection. Though not in all cases the same, if a period is to be fixed, it might, we think, fairly be said to cover in general a period of nine or ten years; (4) that after the lapse of the period of highest protective potency, the efficacy of vaccination to protect against attack rapidly diminishes, but that it is still considerable in the next quinquennium, and probably never altogether ceases; (5) that its power to modify the character of the disease is also greatest in the period in which its power to protect from attack is greatest, but that its power thus to modify the disease does not diminish as rapidly as its protective influence against attacks, and its efficacy during the later periods of life to modify the disease is still very considerable; (6) that re-vaccination restores the protection which lapse of time has diminished, but the evidence shows that this protection again diminishes, and that, to ensure the highest degree of protection which vaccination can give, the operation should be at intervals repeated; (7) that the beneficial effects of vaccination are most experienced by those in whose case it has been most thorough. We think it may fairly be concluded that where the vaccine matter is inserted in three or four places it is more effectual than when introduced into one or two places only, and that if the vaccination marks are of an area of half a square inch, they indicate a better state of protection than if their area be at all considerably below this."

It is evident from the statistics given that the protection afforded by vaccination against small-pox, though lasting for some time, is gradually lost, so that there comes a period when the protection is very slight indeed. Re-vaccination is naturally the first remedy that suggests itself to meet this difficulty, and from the evidence collected by the Commission from the various epidemics that have occurred, and from the vaccination statistics of the various public services, it is made very apparent that the value of re-vaccination as a preventive of small-pox can scarcely be over-estimated. The proof of this is so conclusive, especially where it is based on the observations made on the ordinary staffs of hospitals, nurses, and the like, who are brought into close contact with small-pox patients, that the re-vaccination statistics alone are sufficient to prove the value of vaccination. The position taken up by Sir Guyer Hunter and Mr. Jonathan Hutchinson in this question in their minority report, appears to us to be the only logical one that could be arrived at, although the limits that should be placed upon compulsion, spoken of elsewhere, would also limit us in regard to re-vaccination. Only these two Commissioners recommend that re-vaccination at the age of twelve should be compulsory, and on the same lines as the initial vaccination; but now that School Boards have their age registration of the children in attendance on their schools, it would surely not be a difficult matter to ensure the vaccination of children of that age, in order that they might be protected through a period during which the susceptibility to the disease, though less than in the earlier years of life, is still considerable; the period, too, during which interference with training for work and with production of work is a very serious matter for the individual, and a matter equally serious for the State.

(B) "As to the objections made to vaccination on the grounds of injurious effects alleged to result therefrom; and the nature and extent of any injurious effects which do, in fact, so result." In regard to this they say "a careful examination of the facts which have been brought under our notice have enabled us to arrive at the conclusion that, although some of the dangers said to attend vaccination are undoubtedly real and not inconsiderable in gross amount, yet when considered in relation to the extent of vaccination work done, they are insignificant. There is reason further to believe that they are diminishing under the better precautions of the present day, and with the addition of the further precautions, which experience suggests, will do so still more in the future." The remedy for this, apparently, is the employment of calf lymph, which would wholly exclude the risks as regards both syphilis and leprosy. The second danger does not concern the British public, whilst the risk of syphilis, although real, is an exceedingly small one, even when humanised lymph is employed, and could probably be wholly avoided by care in the selection of the vaccinifer. As regards erysipelas, eczematous eruptions, and vaccinia maligna, calf lymph vaccination appears to have few advantages over arm to arm vaccination. This question is dealt with more fully in the following section.

(C) "As to whether any, and, if so, what means should be adopted for preventing or lessening the ill effects, if any, resulting from vaccination; and whether, and, if so, by what means, vaccination with animal vaccine should be further facilitated as a part of public vaccination." Here again the use of calf lymph is recommended, especially for those who have any doubt as to the source of "arm to arm" lymph. Extension of the age period from three to six months, and the adoption of the legal methods now in vogue in Scotland, are strongly recommended. Special attention is called to the necessity for care and cleanliness, not only during the operation, but also in respect to the instruments used; to the desirability that the operation of vaccination should be done at the child's home, except under special circumstances, to the necessity for postponement of vaccination when erysipelas, scarlet fever, measles, or chicken-pox are prevalent in the neighbourhood of the child's residence, or at the place of vaccination, or on account of the general health of the child, bad surroundings, or other conditions rendering the

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operation at the time undesirable. The following recommendations are also made. The vaccination vesicles should not be opened unless for some adequate reason. The preservation of lymph in tubes instead of dry points (the storage of calf lymph in glycerine?), the careful sterilisation of all instruments used (which should be as simple as possible), and the exercise of care that the insertions of vaccine matter be not placed too close together, so that the vitality of the tissues between them may not be injured. It is thus suggested that greater latitude should be given to the medical man in deciding as to when vaccination should take place. On the other hand, along with compulsion of the parent, compulsion on the medical attendant to attend (should any unfavourable symptoms occur prior to the time fixed for inspection) should be made, and that notice should be given to parents that they are empowered to summon the public vaccinator. It is also pointed out that in any case where a child requires medical attendance owing to illness supervening on vaccination, that it should be the duty of the vaccinator to render such attendance if required by the parent, and that he should receive a fee in respect thereof. The Commissioners go on to state that "in our opinion, if the precautions we have suggested were adopted, untoward incidents of vaccination, already rare, would become much rarer."

Concerning the conditions of vaccination that obtain in Scotland (p. 135 of the Report), it is probable that any legal action that may be taken as a result of the report of the Commission will be based, to a large extent, at any rate, on the provisions of the Scottish Vaccination Act. As pointed out in the *British Medical Journal*, the essential features in which this system differs from that in vogue in England are the following. Almost the entire work of vaccination is carried on by the family doctor, who is paid for the operation and for the succeeding visit, just as he would be paid for an ordinary visit to the child; so that the parents, and not the rates, are charged with the expense. This, however, is a matter of detail, and the Commission recommends that any medical attendance required in consequence of vaccination, is not to be charged against the parents, but against the State. In a few large cities, especially in those where medical schools are located, public vaccination is resorted to. In these cities the public vaccine stations are in most cases in connection with the medical schools, though in some instances they are subsidised by municipal funds. State registration of vaccination is associated with birth registration. When the birth of a child is registered, the registrar hands to the person registering a notice requiring that the child shall be vaccinated within six months of its birth; the notice is accompanied by the usual certificate forms for successful vaccination, postponement, and insusceptibility. Every half-year the registrar sends a note of all who have not complied with the vaccination regulations to the inspector of poor under the Parish Council (Board of Guardians). This list of defaulters is placed in the hands of the public vaccinator, who visits those children who have not been vaccinated at their own home, or sees them at the office or dispensary of the Parish Council. Should the parents refuse to accept vaccination at the hands of the public vaccinator, but not till then, legal pressure may be brought to bear upon the parents, as in England. Of course it is contended that vaccination under these conditions cannot be inspected by a public inspector, and that very great latitude is allowed to the medical man as to what may constitute efficient vaccination; but, on the other hand, the vaccination being done by a trusted medical adviser does not arouse the same opposition that it does in England, with the result that in Scotland vaccination is accepted almost as part of the condition of registration of the birth of the child. A most important consideration in the Scotch system is that, as the period is six months instead of three, many of the dangerous illnesses of very early life, during which such a large proportion of children die, are not put down to vaccination, as they so frequently are in England. It has been suggested, indeed, that this period of six months might, with advantage, be extended to twelve, except when small-pox is epidemic, when vaccination should be done as early as possible. It is a striking fact that during eleven years (between 1884 and 1894) the number of unvaccinated children, *i.e.* those unaccounted for to the registrar, never rose to more than $2\frac{3}{4}$ per cent., and in 1894 this was as low as about $2\frac{1}{3}$ per cent. In the second half-year of 1892 only twenty-two prosecutions were instituted. There can certainly be little doubt that, although there may be slight disadvantages connected with the performance of vaccination by medical men at the homes of the children, these are of such a nature that they could very soon be got over, whilst the enormous advantages far more than outweigh any possible disadvantages. It has been pointed out there would be no need to take the child away from its home; consequently it would not be necessary to expose it to inclement weather, or to rough treatment of any kind, with the result that chills and broken vesicles would be of less frequent occurrence than under the present system. The possible danger of contracting erysipelas, scarlet fever, measles, and like diseases from other children at this time, would also be done away with, could attendance at public vaccination stations be dispensed with.

(D) "As to what means, other than vaccination, can be used for diminishing the prevalence of small-pox; and how far such means could be relied on in place of vaccination." In connection with isolation the Commissioners confess that they can see nothing to warrant the conclusion that in this country vaccination might safely be abandoned, and be replaced by a system of isolation; but whilst fully admitting the protective effect of vaccination, the Commissioners maintain that it does not diminish the importance of measures of isolation, or dispense with their necessity. They hold, moreover, that steps should be taken to procure a more general division of the isolation of small-pox patients than exists at the present time; and they recommend "(1) that common shelters which are not now subject to the law relating to common lodging-houses should be made subject to such law; (2) that there should be power to the local authority to require medical examination of all persons entering common lodging-houses and casual wards to see if they are suffering from small-pox, and to offer a reward for prompt information of the presence of the disease; (3) that the local authorities should have power to order the keeper of a common lodging-house in which there has been small-pox to refuse admission for such time as may be required by the authority; (4) that the local authority should be empowered to require the temporary closing of any common lodging-house in which small-pox has occurred; (5) that the local authority should have power to offer free lodgings to any inmate of a common lodging-house or casual ward who may reasonably be suspected of being liable to convey small-pox; (6) that the sanitary authority should give notice to all adjoining sanitary authorities of the occurrence of small-pox in common lodging-houses or casual wards; (7) that where the disease occurs the public vaccinator or the medical officer of health should attend and vaccinate the inmates of such lodging-houses or wards, except such as should be unwilling to submit themselves to the operation."

One remarkable fact in connection with this part of the question is that even the minority reporters against vaccination (only two in number, although at least four members of the Commission were supposed, originally, to be adverse to its use) can offer no new light on the question; any argument brought forward, in a half-hearted fashion, against the efficacy of vaccination, is based not so much upon actual statistics as upon a purely hypothetical basis.

The alternatives, improved sanitation and isolation, that are advanced in the minority report as being sufficient to take the place of vaccination, were of no avail during the Gloucester epidemic, during which vaccinators and non-vaccinators alike competed with one another in their zeal to have vaccinations and re-vaccinations performed at as early a date as possible; only as the population became well vaccinated did other measures appear to have any material effect in limiting the spread of small-pox. Of the extent of the vaccination that went on in this city, an idea may be gathered from the fact that during one period of seven days four public vaccinators operated on 548 patients for the first time, and re-vaccinated 1683. No medical man would for a moment desire to minimise the importance of improved sanitary surroundings and immediate isolation of small-pox patients in dealing with any outbreak of small-pox, and with the prevention of small-pox epidemics, but from the nature of the disease and the period during which the infective nature of the disease makes itself felt, it is almost impossible to prevent the transmission of small-pox by patients who are suffering from this disease during the earlier periods of its course. Small-pox is undoubtedly seldom transmitted from town to town except through tramps or through people who cannot be readily reached for inspection, simply because they do not apply for medical advice until the disease is well developed; whilst in regard to the cases that are not recognised during the earlier stages of the disease, it is probable that these will, from time to time, become more and more numerous from the fact that as there are periods during which

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very few cases of small-pox are met with, it is impossible (during these periods) for medical men to make themselves familiar with the exact appearances by which they can accurately diagnose small-pox. It is only during periods of epidemic that medical students and practitioners are able to become familiar with the disease. Efficient sanitary administration is undoubtedly valuable because of the greater resistance that patients who are in good health undoubtedly exhibit against the attacks of all diseases, but it can never be hoped that the directly infectious diseases, such as small-pox, measles, and whooping cough, can be diminished by the most stringent sanitary measures, in the same proportion as typhus and the plague have been, and as cholera and typhoid are being reduced. As regards isolation and quarantine, it is evident, of course, that if every case of small-pox could be isolated at the time that infection took place, and if every case could be detained in quarantine-isolation at the part at which it occurred, small-pox might now be stamped out; but even this position could only have been reached by the aid of vaccination, as without doctors and nurses protected by vaccination or previous attacks of small-pox, it would be impossible to find attendants for these isolated patients. But the whole question of stamping out by these measures without vaccination, is so utterly absurd when the conditions under which the disease is generally spread are taken into consideration, that it is really startling that they should have been suggested as capable of taking the place of vaccination, however valuable they may be as accessory factors. One writer, commenting on the example which Leicester is stated to afford of the value of strict isolation, points out, "that vaccination was carried to nearly every one who was thought to have any chance of coming into contact with the disease, and that nearly every member of the hospital staff gladly accepted re-vaccination." The Commissioners reporting on this point state "that at Leicester, the region of isolation and sanitation, two vaccinated children under ten were attacked, neither of whom died; of unvaccinated children of a similar age, 107 were attacked, of whom fifteen, or 14 per cent., died. Of vaccinated persons over ten years of age, 197 were attacked, of whom two died, or 1 per cent.; of the unvaccinated at a similar age, 51 were attacked, of whom 4, or 7·8 per cent., died." In the case of the hospital staff at Leicester, we have a most striking proof of the efficacy of vaccination. On page 82 of the Report, par. 319, we have the following: "At Leicester, at the end of the year 1892, the staff at the hospital consisted of twenty-eight persons. Fourteen of these had either previously had small-pox, or had been re-vaccinated before the outbreak. Eight others were vaccinated at the time of the outbreak. The remaining six, although they had not previously been re-vaccinated, refused to submit to the operation. During the outbreak there was an addition of twelve to the staff dealing with small-pox cases. These were all re-vaccinated, and none of them contracted small-pox. Out of the twenty-eight, six were attacked by the disease, of whom one died. Five of the persons thus attacked, including the one fatal case (the person in whose case the disease was fatal was said to be of intemperate habits), were amongst the six persons who had refused to be re-vaccinated, though in the case of one of the five consent was afterwards given to the operation, but it was only performed on the day that she showed premonitory symptoms of small-pox. The sixth case, a mild one, was that of a nurse who had been re-vaccinated ten years before." Dr. Gayton gives a similar but even more striking instance in connection with the Homerton Small-pox Hospital. The statistics given in connection with the small-pox ship hospitals in connection with the Metropolitan Asylums Board during the twelve years, 1884-1895, are also very conclusive. Amongst the attendants, varying in number from fifty in one year to 300 in another, there have only been three years out of the whole twelve in which cases of small-pox have occurred. In 1884, there were four cases among 283 attendants; in 1892, two cases among 138 attendants; and in 1893, six cases among 230 attendants. These were in close attendance upon small-pox patients in the hospital ship; all had been re-vaccinated, but in six out of the twelve cases where small-pox occurred it developed within fifteen days of admission to the ship, so that the small-pox infection and the introduction of the vaccine matter had taken place at the same time, or, as in at least two cases, the vaccination had been preceded by the small-pox infection. These are most remarkable figures, and offer evidence that well-vaccinated persons may be brought into very close contact with small-pox patients without running more than a minimal risk of contracting the disease; on the other hand, even the most careful isolation cannot prevent the outbreak of small-pox amongst the unvaccinated, unless the isolation takes place before the disease can be actually recognised, the infectivity making itself felt before the disease can be recognised. The report given by Mr. Allanson Picton and Dr. Collins certainly makes out a strong case for isolation and improved sanitation, but nowhere in it, as we have already said, do they put forward any evidence which can be accepted as proving that these are only of secondary value to vaccination during infancy and re-vaccination at stated periods, and we can quite understand how even Mr. Bright and Mr. Whitbread, along with others of the Commissioners, have been brought to see that it is impossible to contemplate the effect of leaving the whole of the population unvaccinated "without the utmost dismay."

(E) "As to whether any alterations should be made in the arrangements and proceedings for securing the performance of vaccinations, and, in particular, in those provisions of the Vaccination Acts with respect to prosecutions for non-compliance with the Law." In this Section we have the crux of the whole question. The course that the Commissioners have taken affords stronger proof of their belief in the efficacy of vaccination than any other recommendation they could have issued. They believe that the case for vaccination is so strong, that when their report is made public, and when people have had time to digest its contents, especially if the stimulus of alleged martyrdom be removed, that much of the opposition to vaccination will disappear, and that, as in Scotland, where proceedings against parents for the non-vaccination of their children are comparatively rare, the opposition to vaccination will gradually be broken down, and compulsory vaccination will no longer be necessary. Going on the principle that failure to comply with the vaccination laws is often the result of carelessness and desire to avoid trouble, although in justification of this carelessness an objection to vaccination may afterwards be developed, the Commissioners suggest that it should be necessary to take at least as much trouble to escape vaccination as to allow the child to be vaccinated. Conscientious objectors are to be allowed to make a declaration before a magistrate; this would be still more effective were it necessary to go before the magistrate in open court. The exact nature of the recommendations of the Commissioners, however, is a matter of very slight importance, as the general impression produced by this report must be overwhelmingly in favour of vaccination; and those who maintain, or rather did maintain, that the Commissioners were of opinion that vaccination was a failure, had either not read the report or had intentionally misunderstood it. As we have pointed out, of those who are against compulsory vaccination, even in the modified form suggested by the majority of the Commissioners, two are still so convinced of its efficacy that they sign the general report; and the other two, although maintaining that isolation and improved sanitary administration are sufficient to cope with the disease, nowhere lay down as a proposition that vaccination affords no protection against small-pox. After a careful perusal of the report we are convinced that, although this Commission has taken seven years during which to sift evidence and make its report, it has, both from the momentous issues at stake, and by the judicious nature of its finding, been thoroughly justified from beginning to end, and that the report will be accepted as one of the best ever presented to our, or to any other, Parliament.

SOME ENGINEERING ADVANCES IN SIXTY YEARS.[1]

WE meet this evening under peculiar circumstances, some of which are of much interest to every member of the empire, and others are specially appertaining to the Institution. These circumstances seem to me to mark the year 1896 as an epoch, at which your President may offer to you some remarks which will be not strictly a review of any of the various recent feats of engineering, but rather a retrospective survey of the general progress with which engineering has been and is intimately connected, and a consideration of some matters past, present, and future, which appear to me to touch closely the interests of us all as members of the profession.

The material advances which this country has made during the Queen's reign are so remarkable, and have depended so

[1] Abstract of the presidential address delivered before the Institution of Civil Engineers on November 3, by Mr. J. Wolfe Barry, C.B., F.R.S.

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